

## 2. Location: Mean, Median & Mode

### Exercise 2.1 — The mean

Q1 The sum of all 12 prices is £13.92.  
So the mean price is  $£13.92 \div 12 = £1.16$

Q2  $2387 \div 17 = 140$  g/km (3 s.f.)

Q3

Number of goals, $x$	0	1	2	3	4	Total
Frequency, $f$	5	7	4	3	1	20
$fx$	0	7	8	9	4	28

So the mean is  $28 \div 20 = 1.4$  goals

Q4 Old total of ages =  $15 \times 47.4 = 711$  years  
New total of ages =  $711 + 17 = 728$  years  
So new mean =  $728 \div 16 = 45.5$  years  
Or you could have used the formula with  $n_1 = 15$ ,  $\bar{x}_1 = 47.4$ ,  $n_2 = 1$  and  $\bar{x}_2 = 17$  to get the same answer.

### Exercise 2.2 — The mode and the median

Q1 a) First put the amounts in order:  
£19, £45, £67, £77, £84, £98, £101, £108, £110, £123, £140, £185, £187, £194, £216, £250, £500  
There are 17 amounts in total. Since  $17 \div 2 = 8.5$  is not a whole number, round this up to 9 to find the position of the median.  
So the median = £110.

b) All the values occur just once.

Q2 a) 6.9%

b) First put the rates in order:  
6.2%, 6.2%, 6.3%, 6.4%, 6.4%, 6.5%, 6.9%, 6.9%, 6.9%, 7.4%, 8.8%, 9.9%  
There are 12 rates in total. Since  $12 \div 2 = 6$  is a whole number, the median is halfway between the 6th and 7th values in the ordered list.  
So the median =  $(6.5\% + 6.9\%) \div 2 = 6.7\%$ .

Q3 a) 5

b) There are 176 ratings in total.  
 $176 \div 2 = 88$ , so the median is midway between the 88th and 89th values.  
Add a column to the table to show cumulative frequencies:

Rating	Number of customers	Cumulative frequency
1	7	7
2	5	12
3	25	37
4	67	104
5	72	176

From the cumulative frequencies, the 88th and 89th values are both 4, so the median = 4.

Q4 a) 5 seats

b) There are 35 values altogether.  
Since  $35 \div 2 = 17.5$  is not a whole number, round this up to 18 to find the position of the median.  
So the median = 20 seats.

- b) (i) There are 19 values altogether.  
Since  $19 \div 2 = 9.5$  is not a whole number, round this up to 10 to find the position of the median.  
So the median = 5.8 Mbit/s.
- (ii) There are 22 values altogether.  
Since  $22 \div 2 = 11$  is a whole number, the median is halfway between the 11th and 12th values in the ordered list.  
So the median =  $(5.5 + 5.9) \div 2 = 5.7$  Mbit/s.

### Exercise 2.3 — Averages of grouped data

Q1 a)

Time ( $t$ , mins)	Frequency, $f$	Mid-point, $x$	$fx$
$3 \leq t < 4$	7	3.5	24.5
$4 \leq t < 5$	14	4.5	63
$5 \leq t < 6$	24	5.5	132
$6 \leq t < 8$	10	7	70
$8 \leq t < 10$	5	9	45

b)  $\sum f = 60$ ,  $\sum fx = 334.5$   
So estimate of mean =  $334.5 \div 60$   
= 5.6 mins (to 1 d.p.).

Q2 a) 0-2 letters

All the classes are the same width, so use the frequency to find the modal class (instead of the frequency density).

b) Add some extra columns to the table:

Number of letters	Number of houses, $f$	Mid-point, $x$	$fx$
0-2	20	1	20
3-5	16	4	64
6-8	7	7	49
9-11	5	10	50
12-14	2	13	26

$\sum f = 50$ ,  $\sum fx = 209$   
So estimate of mean =  $209 \div 50 = 4.18$  letters

c) Since  $\sum f \div 2 = 50 \div 2 = 25$ , the median is halfway between the values in this position (25) and the next position (26) in the ordered list.  
So the median must be in the class 3-5.

Q3 Add a cumulative frequency column to the table:

Rainfall ( $r$ , mm)	Frequency	Cumulative frequency
$20 \leq r < 40$	5	5
$40 \leq r < 50$	7	12
$50 \leq r < 60$	9	21
$60 \leq r < 80$	15	36
$80 \leq r < 100$	8	44
$100 \leq r < 120$	2	46

So  $\frac{n}{2} = \frac{46}{2} = 23$ , meaning the median must lie in the class ' $60 \leq r < 80$ '.

- Q5** a) (i) 4.0 Mbit/s, 5.8 Mbit/s and 6.9 Mbit/s  
(ii) 6.2 Mbit/s

- Q4** a) Estimated mean =  $16\,740 \div 60 = 279$  minutes  
b) Add a cumulative frequency column to the table:

Time ( $t$ , mins)	Frequency, $f$	Cumulative frequency
$180 \leq t < 240$	8	8
$240 \leq t < 270$	19	27
$270 \leq t < 300$	21	48
$300 \leq t < 360$	9	57
$360 \leq t < 480$	3	60

So  $\frac{n}{2} = 30$ , meaning the median must lie in the class ' $270 \leq t < 300$ '.